

## COMMERCIAL MANUFACTURING OF PASTEURIZED MANGO FRUIT FLAVOURED MILK-BASED BEVERAGES

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Mango, the king of fruits, is cherished by the rich and the poor alike in Pakistan for its organoleptic, nutritive and therapeutic values. Milk-shakes and mango-fruit beverages are among the most popular beverages in summer. By using different levels of the pulp of 'Chaunsa' variety of mango, and the three popular stabilizers 18 beverages were prepared; and after one day's cold storage, these were organoleptically evaluated by a panel of judges to select the best beverage. Mexpectin RS-450 gave the best results and that formulation was industrially manufactured by HTST pasteurizing and homogenizing at 80°. The industrially manufactured product was packed in brick packs on combi-block machine and by using the triangle taste test, the shelf-life was observed to be 49 days when kept refrigerated.

**Key words:** Mango, Milk-based beverages, HTST pasteurization.

### Introduction

The loss of body fluids from exertion, temperature, or age gives rise to thirst. The fluids lost are accompanied by a loss of electrolytes, vitamins, lactates, amino acids, and other organic compounds. This imbalance is communicated to the brain, and the resultant sensation of dryness in the mouth is known as thirst. Although water is the best thirstquencher, a milk beverage is a good substitute. It not only refreshes, but also replaces much of the lost organics and inorganics to the extracellular fluid. Flavoured milks, milk-shakes and milk-based fruit beverages are, therefore, popular all over the world. The studies so far conducted on fruit-flavoured beverages in the Western world mostly relate to fruits commonly grown in that region. As Pakistan has its own indigenous species of fruits, it was felt that a study ought to be undertaken to use one of its best fruits. Mango is cherished by the rich and the poor alike in our country, which is the third largest mango-producing country in the world after India and Brazil [1] and grows some of its best varieties. It is rightly called the king of fruits, for its organoleptic, nutritive and therapeutic values. It contains not only appreciable quantities of vitamins, minerals and calories, but its pulp is also delectable. If mixed in milk, it becomes luscious and tastier. It was for this reason that the choice primarily fell on mango. Another reason for this venture was the fact that in Pakistan no commercial dairy or juice plant was producing milk-based beverages on the industrial scale. Thus a project was initiated to develop a formulation which could be industrially adopted by using locally available skimmed milk powder (SMP), mango fruit of the Chaunsa and three popular stabilizers. The Chaunsa variety was chosen for its captivating flavour and its exquisite and tasty pulp, as these elements were expected to

add a new dimension to the quality uplift of the milk-based beverage.

Charley [2] recommended that the fruit-flavoured milks meant for retail should always be pasteurized, but not sterilized, because it increased the pH of the additive cordial, and the products became unacceptable.

Doesburg and deVos [3] came to the conclusion that good results could be obtained by mixing powdered pectin (stabilized with sugar) with milk before adding the acid component. The quantity of pectin was sufficient when the percentage in the finished beverage, multiplied by the jelly grade of the pectin, was 200 or more, as during storage pectin also acted as a stabilizer.

Korn [4] manufactured guava and mango fruit-flavoured milk by mixing whole or partially skimmed milk with juice of guava and mango fruit, each at 3-15% by volume, keeping the ratio of the two components at 1:5 or 5:1, and reported that the low acid content of the fruits used reduced the risk of milk coagulation and suppressed an excessive formation of gastric acids. This beverage had a higher nutrient and vitamin content.

Rehman [5] reported that Mexpectin RS-450 gave better organoleptic characteristics when used in banana-flavoured milk-based drinks prepared by using buffalo's and cow's milks.

### Materials and Methods

Mango pulp, SMP, and other ingredients were locally purchased. The study was divided into two parts, the first one pertained to manufacture of different quality beverages by varying the levels of SMP, fruit content and stabilizers in the Fruits and Vegetable Laboratory of the Department of Food Technology, University of Agriculture, Faisalabad, in the



summer of 1988. In this part 18 formulations were manufactured (Table 1), and by employing 9-point Hedonic scale as described by Larmond [6] the acceptable formulations and the best one were screened out.

The second part of the study pertained to the manufacture of the beverage on industrial scale by employing the best formulation screened out through the first part of the study, and then study its shelf-life by using triangle test [6].

*First part of the study.* In the first part of the study, the stabilizers tested were: (i) Grindsted's Mexpectin RS-450, (ii) Carboxymethyl-cellulose (CMC), and (iii) Grindsted's Gelodan S.M.

Powder milk offers more convenience than fluid milk because it directly gives standardized milk, skimmed milk powder (SMP) was used at the rate of 3% in manufacturing all the formulations. Cane-sugar was added at the rate of 13%, sodium citrate (0.02%), potassium sorbate (0.01%) and citric acid (0.2%) were the other ingredients. Water was used so as to make the volume 100%. The method of manufacture is given below:

- (i) SMP, sucrose, stabilizer, sodium citrate, and potassium sorbate were dryblended and then dissolved in water;
- (ii) Stability time of 15 min. was given for proteins stabilization;
- (iii) Pulp, flavour, colour and citric acid were added;
- (iv) The mix was HTST (High Temperature Short Time) pasteurized at 80° for 15 sec., and homogenized;
- (v) Filled into pre-sterilized bottles and crown corked. In order to ensure proper sealing they were inverted, and then
- (vi) Chilled and stored in a refrigerator.

For selection of the formulation that was to be employed in the milk plant for the manufacture of pasteurized mango fruit- flavoured milk-based beverages, the 18 beverages so prepared in the laboratory were subjected to sensory evaluation, after one day of refrigerated storage, by a trained panel of seven judges. The judges applied the 9-point Hedonic scale as described by Larmond [6]. The numerical values were equivalent to:

(1) = Dislike extremely, (2) = Dislike very much, (3) = Dislike moderately, (4) = Dislike slightly, (5) = Neither dislike nor like, (6) = Like slightly, (7) = Like moderately, (8) = Like very much, and (9) = Like extremely.

The scores were then statistically analyzed by using the analysis of variance technique as described by Steel and Torrie [7]. Out of the 18 preparations, the most-liked formulation was picked up.

*Second part of the study.* The most like formulation screened out through the first part of the study was industrially manufactured at the Milk Ways Ltd., Tandlianwala, where it was HTST pasteurized at 80° for 15 sec., homogenized at the

same temperature at 2000 psi, and the pH' was maintained at 4.5. The product was packed in 500 ml. 'Brick Packs' on Combiblock machine and was transported in a refrigerated tank car, to the Fruits and Vegetables Laboratory of the Department of Food Technology, University of Agriculture, Faisalabad, where it was kept refrigerated throughout the time of study. By using triangle test, as described by Larmond [6], it was further studied. At every testing three samples were presented to every member of the taste panel. Two samples of these were identical and original, i.e., as manufactured at the milk plant. A third sample was prepared by opening the original sample just before sensory evaluation, and mango essence prepared by Standard Manufacturing Company (SMC) was added into it, and it was treated as an odd sample. These three samples, along with the proforma (Table 2), were then presented to each judge for sensory evaluation after a week's interval up to the end of the study. The data obtained was statistically analyzed as described by Larmond [6] by employing the statistical charts prepared by Roessler *et. al.* [8].

### Results and Discussion

*First part of the study.* The results obtained on the 9-point Hedonic scale for the sensory evaluation of the 18 formulations prepared in the laboratory are shown in Table 3. The aggregate scores, (out of 27, i.e., colour 9, taste 9, and flavour

TABLE 1. LEVELS OF DIFFERENT STABLIZERS, MANGO PULP CONTENTS AND THEIR TREATMENT CODES.

Code	Stablizer	Level (%)	Mango pulp (%)
A-1	Grindsted's Mexpectin RS-450	0.2	1
A-2	Grindsted's Mexpectin Rs-450	0.3	1
B-1	Grindsted's Mexpectin RS-450	0.2	2
B-2	Grindsted's Mexpectin RS-450	0.3	2
C-1	Grindsted's Mexpectin RS-450	0.2	3
C-2	Grindsted's Mexpectin RS-450	0.3	3
D-1	Carboxymethyl cellulose	0.2	1
D-2	Carboxymethyl cellulose	0.3	1
E-1	Carboxymethyl cellulose	0.2	2
E-2	Carboxymethyl cellulose	0.3	2
F-1	Carboxymethyl cellulose	0.2	3
F-2	Carboxymethyl cellulose	0.3	3
G-1	Grindsted's Gelodan S.M	0.2	1
G-2	Grindsted's Gelodan S.M	0.3	1
H-1	Grindsted's Gelodan S.M	0.2	2
H-2	Grindsted's Gelodan S.M	0.3	2
I-1	Grindsted's Gelodan S.M	0.2	3
I-2	Grindsted's Gelodan S.M	0.3	3
			Total = 18



9) obtained after statistical analysis are shown in Table 4. These showed highly significant difference for the various treatments employed. The average scores revealed that (a) nine treatments fell in the "dislike slightly" group, (b) four in the "neither dislike nor like" group, (c) four in the "like slightly" group, and (d) treatment C-2, which was manufac-

TABLE 2. EVALUATION PROFORMA.

Week: \_\_\_\_\_

Taster: \_\_\_\_\_ Dated: \_\_\_\_\_

*Product: Milk-Based Dairy Drink*

You are provided with 3 samples, two of these are identical and the third one is odd. Kindly tick the appropriate one.

(i). Can you detect a difference in these samples ?

Yes \_\_\_\_\_

No \_\_\_\_\_

(ii). Please indicate the degree of difference:

Slight \_\_\_\_\_

Moderate \_\_\_\_\_

Much \_\_\_\_\_

Extreme \_\_\_\_\_

(iii). Which one is the odd (Please tick) ?

321 \_\_\_\_\_

564 \_\_\_\_\_

786 \_\_\_\_\_

(iv). Which is the best (Please give the code) ?

TABLE 3. SCORES FOR THE MANGO FRUIT-FLAVOURED MILK-BASED BEVERAGES PREPARED ON LABORATORY SCALE.

Sr. No.	Treatment Codes	Scores obtained on the Hedonic scale							Total
		I	II	III	IV	V	VI	VII	
<i>Pectin stabilized beverages</i>									
1	A-1	13	13	11	11	13	13	13	87
2	S-2	14	14	14	12	14	13	14	95
3	B-1	19	18	17	17	19	18	17	125
4	B-2	21	20	21	23	22	18	17	146
5	C-1	20	21	20	22	21	21	20	145
6	C-2	22	22	22	24	24	22	22	158
<i>C. M. C. Stabilized beverages</i>									
7	D-1	12	13	12	13	13	11	11	85
8	D-2	13	13	13	14	14	12	12	91
9	E-1	15	16	14	14	15	12	13	99
10	E-2	16	17	16	16	16	13	14	108
11	F-1	19	20	20	18	18	17	16	128
12	F-2	19	18	16	17	18	17	17	122
<i>Gelodan stabilized beverages</i>									
13	G-1	15	14	13	11	12	13	12	90
14	G-2	12	14	13	14	14	13	13	93
15	H-1	18	18	18	18	17	18	17	124
16	H-2	14	15	14	13	14	16	14	100
17	I-1	20	20	18	20	18	18	18	132
18	I-2	15	18	15	14	14	13	13	102

tured by using Mexpectin RS-450, was adjudged as the best.

It, therefore, appeared that Mexpectin RS-450 did not contribute any off-flavour and taste, and tended to check coagulation of casein and separation of constituents, thereby giving a better quality product. It confirmed the report of Rembowski *et. al.* [9] that the pectin was best for milk

TABLE 4. AGGREGATE SCORES FOR OVERALL ACCEPTABILITY OF MANGO FRUIT FLAVOURED MILK-BASED BEVERAGES PREPARED ON LABORATORY SCALE (AVERAGE OF 7 JUDGES).

Treatment codes	Ranks	Means
C-2	1	22.57 a
B-2	2	20.86 b
C-1	3	20.71 b
I-1	4	18.57 c
F-1	5	18.29 c
B-1	6	17.86 c
H-1	7	17.71 c
F-2	8	15.71 d
E-2	9	15.43 de
I-2	10	14.57 ef
H-2	11	14.29 fg
E-1	12	14.14 fg
A-2	13	13.57 fgh
G-2	14	13.29 ghi
D-2	15	13.00 hi
G-1	16	12.86 hi
A-1	17	12.43 hi
D-1	18	12.41 i

Note: Means followed by the same letter do not differ significantly at  $p = 0.05$  according to DMR tests.

TABLE 5. RESULTS OF TRIANGLE TEST.

Identified	Weeks							
	W-1	W-2	W-3	W-4	W-5	W-6	W-7	W-8
Correctly	5	5	6	6	6	6	7	7
Incorrectly	2	2	1	1	1	1	0	0
Total	7	7	7	7	7	7	7	7

TABLE 6. DEGREE OF DIFFERENCE INDICATED BY THE JUDGES WHO CORRECTLY IDENTIFIED THE ODD SAMPLES.

Degree of Difference	No. of Judges	Value
Slight	1 x 1	= 1
Moderate	3 x 2	= 6
Much	1 x 3	= 3
Extreme	1 x 4	= 4
Total	6	= 14
Mean		2.33

Average difference = 2.33 (moderate).



beverages containing fruits. Grindsted's Mxpectin RS-450 was twice as effective against serum separation and sediment formation in drinking yoghurt as conventional pectin [10].

The four treatments which fell in the "like slightly" group were B-2, C-1, I-1, and F-1. Thus, the trails revealed that out of the 18 formulations tested, only the following five were acceptable:

- (1). B-2 SMP: Mango pulp: Mxpectin RS-450 (3%: 2%: 0.3%),
- (2). C-1 SMP: Mango pulp: Mxpectin RS-450 (3%: 2%: 0.2%),
- (3). C-2 SMP: Mango pulp: Mxpectin RS-450 (3%: 3%: 0.3%),
- (4). F-1 SMP: Mango pulp: C.M.C. (3%: 3%: 0.2%),
- and (5). I-1 SMP: Mango pulp: Gelodan S.M. (3%: 3%: 0.2%).

*The second part of study.* As the first part of study placed formulation C-2 on the top (Table 4) therefore, it was selected for manufacturing the product on industrial scale at the Milk Ways Limited, Tandlianwala. It contained

(1). Sucrose.	13.000%
(2). Mango pulp.	3.000%
(3). Skimmed milk powder (SMP).	3.000%
(4). Stabilizer.	0.300%
(5). Citric acid.	0.200%
(6). Sodium citrate.	0.020%
(7). Potassium sorbate.	0.010%
(8). Colour.	0.002%
(9). Water.	80.468%
	<hr/> 100.000%

To judge the quality, the triangle test was used (Table 5). On zero and first week's evaluation five out of seven judges correctly matched original sample by the triangle test. These, when computed with the statistical chart prepared by Roessler *et al.* [8] indicated a detectable difference between the two samples, i.e., original and added essence samples. On second to fifth week's testing six out of seven judges correctly matched the samples. It is evident from Table 5 that on 6th and 7th week's evaluation every judge correctly matched the original samples. According to Roessler's statistical chart, six correct judgements out of seven in a triangle test indicate a significant difference at 1% level.

The degree of difference indicated by the six judges, who correctly identified the odd sample, is shown in Table 6, which revealed it to be moderate (2.33).

The next part of the triangle test was to choose the more acceptable sample. Of the six judges who correctly identified the odd sample, five slightly like it more than the original product. According to Roessler's statistical chart, these results were significant at 5% level. As in the odd samples the flavour was freshly added, therefore, the judges slightly liked it more than the original product. But, all of the judges admired alike the original product for its organoleptic characteristics, and also because of the finest quality of mango used in the process.

After evaluating the product on 49th day (7th week) the taste panel declared it to be unfit for consumption and refused to evaluate it further. This could be due to destabilization of proteins during storage, accompanied by other chemical changes which rendered the product unacceptable.

It can, therefore, be established that when pasteurized mango fruit flavoured milk-based beverages are kept refrigerated, their life could be up to 49 days.

### Conclusions

- (i) Milk-based fruit-flavoured beverage could be manufactured from locally available raw ingredients, thereby reducing dependence on imported concentrates.

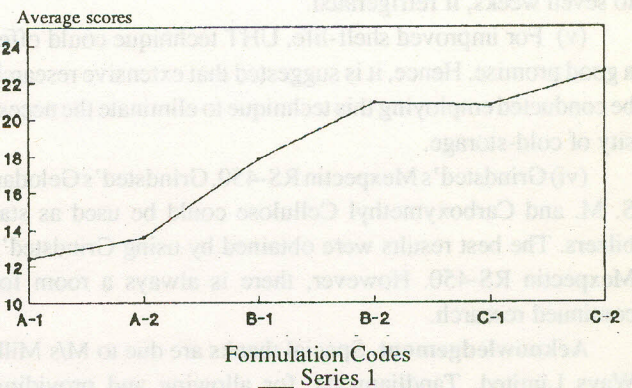


Fig. 1. Acceptability of Mxpectin stabilized drinks.

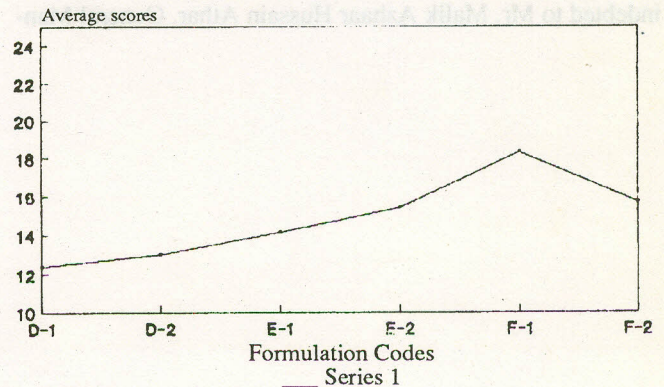


Fig. 2. Acceptability of CMC stabilized drinks.

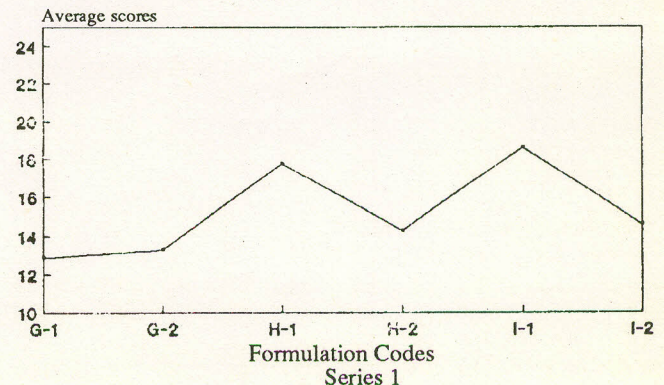


Fig. 3. Acceptability of Gelodan stabilized drinks.



(ii) Milk-based fruit-flavoured beverages are refreshing, thirst quenching and have higher nutritive value than the soft drinks. Hence, increased milk consumption accompanied by a reduction in soft drink intake is strongly recommended both on nutritional and economic grounds.

(iii) This brand of nutritionally rich drinks could be developed by incorporating different fruits in milk to suit the taste of the consumer.

(iv) Milk-based fruit beverages could be prepared on industrial scale by employing pasteurization technique but the shelf-life of such beverage would be hardly a week under ambient conditions. However, their life could be extended up to seven weeks, if refrigerated.

(v) For improved shelf-life, UHT technique could offer a good promise. Hence, it is suggested that extensive research be conducted employing this technique to eliminate the necessity of cold-storage.

(vi) Grindsted's Mexpectin RS-450, Grindsted's Gelodan S. M. and Carboxymethyl Cellulose could be used as stabilizers. The best results were obtained by using Grindsted's Mexpectin RS-450. However, there is always a room for continued research.

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